A Genotypical Analysis of Korean REMCs and Generation of Base Line Data for the Analysis and Evaluation for Future (REMCs) Designs Using Space Syntax

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Abstract

Purpose: The purpose of this paper is to analyze the spatial configurations of a sample of Korean regional emergency medical centers (REMCs) to explore its underlying genotypes and thus produce a base line data for the analysis and evaluations of future REMCs designs using space syntax theory. **Methods**: Space syntax analysis was used as a major tool for the analysis and exploration of Genotype. The measures of Integration(overall integration with exterior and without exterior as well as the integration of individual clinical spaces for each center), base difference factor (DF) and Space link ratio were calculated for a sample of seven Korean REMCs. **Results**: The result shows a strikingly similar pattern of Syntactic measures across the sample, the mean integration of sample ranges from 0.82-0.99 with exterior (while considering the exterior space as a root) and 0.81-1.01 without exterior (considering the connections of interior spaces only with no outside connection). The base difference factor (DF) of the sample varies from 0.60-0.81 with exterior and from 0.59-0.82 without exterior. Case number-1 was identified as non-genotype with differing order of Syntactic values. Although the genotype had different forms, layouts and even sizes, these results cannot be explained by Phenotypical comparisons. **Implications**: This study will contribute to the configurational analysis and evaluation of existing and future Korean REMCs design and practice of emergency healthcare delivery system in Korea.

Keywords   Korean Regional Emergency Medical Center (REMC) Design, Genotype, Phenotype, Spatial Configuration, Design Evaluation.

1. Introduction

1.1 Background

The rise in life expectancy rate in Korea cannot be separated from an improved healthcare system, where the room for improvements has been utilized and will probably continue in the future. The rapid urbanization, overcrowding and aged population of Korean society brought with itself the vulnerability of exposure to emergency situation and demands for improved emergency care.

Although the leading cause of death in Korea of the age 65 or above is cancer but in teens, twenties, thirties, forties and fifties the five leading causes of death   [Table 1], shows the majority of death causes are directly related to the emergency situations. Therefore an improved emergency care will help in preventing the number of these causalities.

Particularly, when asked where a problem occurs in treating an emergency patient with trauma, 'emergency room (58.8%)' was most responded. Regarding a death

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related problem, 64.3% took place in an emergency room. The preventable death rates among patients with trauma were 35.2%, about 10-15% higher than the U.S. and Japan. Which means that it is also necessary to improve facilities as well as medical staff and equipment in an emergency room as soon as possible.[1)]

[Table 1] Statistics of Death Causes (2015)

unit:(per 100,000 population)

No.	Teens	Twenties	Thirties	Forties	Fifties
1	Transport accidents (4.8)	Intentional self-harm (suicide) (17.8)	Intentional self-harm (suicide) (27.9)	Malignant neoplasms (cancer) (48.6)	Malignant neoplasms (cancer) (144.6)
2	Intentional self-harm (4.5)	Transport accidents (6.0)	Malignant neoplasms (cancer) (14.7)	Intentional self-harm (suicide) (32.4)	Intentional self-harm (suicide) (36.4)
3	Malignant neoplasms (cancer) (2.6)	(Malignant neoplasms (cancer) (4.1)	Transport accidents (5.9)	Liver diseases (13.2)	Heart diseases (29.3)
4	Accidental submersion and drowning (0.6)	Heart diseases (1.5)	Heart diseases (4.2)	Heart diseases (12.2)	Liver diseases (26.7)
5	Heart diseases (0.5)	Cerebrovascular diseases (0.7)	Cerebrovascular diseases (3.0)	Cerebrovascular diseases (10.1)	Cerebrovascular diseases (22.1)

Source: Statistics Korea, Causes of Death Statistics[2)]

1.2 Objectives of the Study

According to the Korean national emergency medical center, "Although the purpose and principles of different EMS (Emergency medical services) are similar to one another, each country has developed (EMS) under their own socio-medical systems and natural environments."[3)] Based on the above, the purpose of this paper is twofold as follows:

First to examine the configuration of a sample of seemingly different Korean REMCs from across the country using space syntax to find out its dominant genotypes if any.

Secondly to produce a baseline data and method for the design and evaluation of Regional EMC designs in the future.
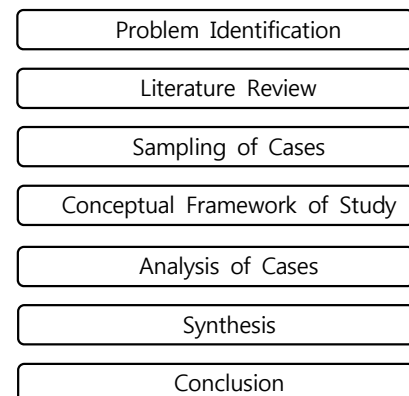
1.3 Problem Statement

According to many theorist, Evaluation is one of the integral part of architectural design, where design is checked against a set of parameters before finalization.

Critical questions of this paper are:

How does an architect evaluate his/her ideas or test the spaces that s/he has created?

What are the parameters or baseline data for spatial analysis? What is the tool or methodology of spatial evaluation?

Problem Identification

Literature Review

Sampling of Cases

Conceptual Framework of Study

Analysis of Cases

Synthesis

Conclusion

[Figure 1] Study Flow Chart

1.4 Method and Scope

To understand the Korean REMC, this study selected seven representative samples from all of the twenty REMCs across the country (Table 2).

The following six aspects spatial configurations were calculated using space syntax softwares of UCL Depthmap and AGraph.[4)]

① The space-link Ratios

② Minimum, Mean and Maximum Integration with exterior

1) Park, Su-Roh, 2013, A Study on the Spatial Configuration of Severe Trauma Center-Focused on Regional Emergency Medical Center, Master Thesis, Department of Design Studies, Hanyang University, pp. 84,85

2) "2015 Statistics on the Aged" Causes of death, http://kostat.go.kr/portal/eng/pressReleases/1/index.board?bmode=read&aSeq=349205, Statistics Korea, 2016.02.26

3) "History EMSS", http://eng.nemc.or.kr/eng/emss/emss_about.jsp , National Emergency Medical Center, 2015.08.05.

4) Manum B.; Rusten E.; Benze P: AGRAPH, Software for Drawing and Calculating Space Syntax "Node-Graphs" and Space Syntax "Axial-Maps", http://www.ntnu.no/ab/spacesyntax/ 2015.06.20.

③ Minimum, Mean and Maximum Integration without exterior

④ Integration of the Individual clinical spaces

⑤ The Base difference factor (DF) with exterior

⑥ The Base difference factor (DF) without exterior

In order to unveil the spatial configuration and its dominant Genotypes of the Korean REMCs, this study deployed syntactic tools for analysis due to the followings:

① Syntactic analysis use topological distance instead of metric distance, that is a same sized building will have different syntactic values if its configuration is changed.[5]

② The measure of real relative asymmetry (RRA) was used instead of Relative Asymmetry (RA); where the effect of the size on the value of RA is eliminated by converting to RRA.

2. Literature Review

2.1 An Overview of Emergency Department

1) Definition of Emergency Department

Emergency departments are dedicated diagnostic and treatment areas intended for those patients urgently requiring medical treatment for injury or illness. Because of the location, convenience, and 24-hour operation of these facilities, non-emergency patients are also frequent users of emergency departments for more routine care or mild ailments.[6]

2) Korean Emergency Medical Service System (EMSS)

Korea's emergency medical services system (EMSS) began and developed alongside the outstanding economic growth and high standards of living.

At present there are 554 emergency medical centers operating in Korea out of which 20 are REMCs, at least one in every region since 2005 (Table 2)[7].

3) Korean Law about Regional Emergency Medical Centre:

Regional Emergency Medical Centre specific criteria (Article 13, paragraph 2 related)

(1) General Criteria

[Table 2] Statistics of emergency medical center (2013)

Statistics of Emergency Medical Center (2013)						
By Region	Total	REMC	SEMC*	LEMC‡	LEMF♣	Etc
Number	554	20	2	119	293	120

① REMCs provide services for emergency patients. The facilities and buildings are established and operated independent of other medical services. Examination rooms and main operating rooms, however, do not require being in another building if they are located in the main building of the hospital.

② Examination rooms, Radiography rooms, intensive care units and operating rooms for the emergency patients should be located and operated in the closest vicinity to one another on the same floor or in the same building.

(2) The Individual criteria

The Korean law about individual spaces of REMC building, their number and the required area as well as the preferred vicinity is given below (Table 3).

2.2. Space syntax:

1) Introduction:

Space syntax is a tool that provides quantitative measures of space, both for individual space (e.g., a room, a corridor) and overall layout (e.g., clinic, ED, entire hospital).

Primarily, Syntax is a method of investigating spatial complexes in an attempt to identify its particular structure that resides at the level of the entire configuration.

Space Syntax is a theory about understanding architecture and urban areas from the point of view of their configuration.

2) Genotype and Phenotype

Genotype means the "internally coded, inheritable information" carried by all living organisms and the "outward, physical manifestation" of the organism is called phenotype.[8]

5) Hillier, Bill & Hanson, Julienne, 1984, The social logic of space, Cambridge university press, New York, p.150
6) Kobus, Richard L. 2000, Building Type Basics for Healthcare Facilities ,Vol. 1, John Wiley & Sons, p.212
7) http://nemc.or.kr/egen/inf.emb13.do?flag=8, National Emergency Medical Center, 2015.08.05.

* Special Emergency Medical Center
‡ Local Emergency Medical Center
♣ Special Emergency Medical Facilities
8) Blamire, John, 2000, "Genotype and Phenotype Definition." http://www.brooklyn.cuny.edu/bc/ahp/BioInfo/GP/Definition.html, Department of Biology, Brooklyn College, 2015.08.05.

[Table 3] Facilities criteria

Facilities	No's	Unit Area(m²)	Total area(m²)	Remarks
Triage	1	30	30	Nearby the main patient entrance gate
Resuscitation room	2	20	40	Nearby the main patient entrance gate and Ambulance Entrance Near to Small surgery Room
Nursing Station	1	20	20	In front of Resuscitation Room
Emergency Patients Medical areas	1	165	165	At least 30 Beds
Laboratory	1			Sufficient space for equipment
Radiation Room · General Ration · CT Scan · Film developing room	1 1 1	30 60	30 60	
Surgery Room · Small Surgery Room · Large surgery Room	1 1	50 40	50 40	
ICU Beds	20	10	200	Exclusive of the Space for Nurse station, equipment and doctor room
Emergency Beds	30	4.3	130	
Conference room and Library	1each	60 each		Space for audiovisual and training equipment
Executive office	1			Separate area required for hospital and medical insurance billing services
Doctor on call room	1			Sufficient space to accommodate two doctors with space for rest and eating
Guardian waiting room	1	100	100	For 30 persons with amenities Adjust the area according to the number of patients
Emergency Medical Information Center	1	130	130	In accordance with the law Article 27 (3) provisions, but installation if entrusted with the task of emergency medical information center operations, exchange chamber, machine room, sufficient space for operations, such as information center administrative office, working the waiting room, and ambulances and medicalI will be secured between wired and wireless networks
Parking				At least four vehicles at same time of which two are ambulance

In space syntax literature the term genotype is used for the Syntactic consistencies in the spatial configuration of a sample of buildings from a region. When these syntactic consistencies are very different then the differing building are labeled as non-genotype.

These consistencies represent the embedded cultural code of a specific region in their buildings which is sometimes difficult to observe by their phenotypical comparisons. According to Hillier, Hanson and Graham "cultural ideas are objectively present in artefacts as much as they are subjectively present in minds."[9]

2.3. Design Evaluation:

Design evaluation is conducted in three stages;

① Evaluation before design,

② Evaluation during design and

③ Evaluation after design.

The focus of this paper is evaluation before design and evaluation during the design process. Evaluation research and its results can be used as:

① Be fed-forward; where the results of studies of existing buildings are applied to the construction of other new buildings,

② Fed-in; whereby evaluation research is conducted for a building in the design and construction process, and

③ Fed-back into an existing building designs.[10]

The last use of evaluation belongs to the Post Occupancy Evaluation (P.O.E.) application, and will not be

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9) Hillier, Bill, Hanson, Julienne, & Graham, H., 1987, "Ideas are in things-An application of the space syntax method to discovering house genotypes", Environment and Planning B: Planning and design, Volume 14, p. 36

10) Donald, I. (1988) "Place evaluation", in "Environmental policy assessment and communication", Canter,D.,Krampen,M. &Stea,D. (Eds), Avebury.

dealt with in this paper. Some researchers, however, have advanced the possibility of using Space Syntax to support new designs and decision-making. Despite this potential, exploration into how Space Syntax can be translated into practical opportunities has been limited.[11]

Therefore this paper will analyze the korean REMCs to produce a baseline data for the design and evaluation of new as well as existing REMC buildings. By doing so this paper will contribute the to use of space syntax for practical opportunities of design and evaluation and will try to fill in the research gap.

2.4. Space Syntax and Design Evaluation

Within applied architectural research, Space Syntax has established its role in the evaluation of building designs. Because of its capability of providing a better understanding of built environments in relation to their topological description, Space Syntax provides "tools for architects to explore their ideas, to understand the possible effects of their proposals, as well as to show how their designs will work."[12] While conventional building performance tests offer information primarily on the physical qualities of a building (i.e. lights, energy consumption, costs, etc.), Space Syntax theory offers a valid instrument to evaluate building designs with a qualitative and quantitative approach. In particular, the relationship between space and society, Space Syntax offers an opportunity to unveil how space and users reciprocally adapt to each other and reorganize themselves.[13] Its approach to the reading and understanding of spatial structures exposes possible relations between form and function at a configurational level.

Space syntax theory offers methods for the evaluation of spatial configurations with respect to users and thus provide a measurement of the functional and socio-cultural

aspects of design which shapes a building for a specific use with respect to user group from a region.

3. Case Studies

3.1 Overview of the Cases

Seven Cases were randomly selected from all of twenty Korean REMCs for the analysis. Detail description of each building was omitted to shift the main focus of the study on the Configurational analysis. All the cases were analyzed using AGraph for Justified Graphs and space-link ratios were calculated from the justified graphs for each case.

Depth map was used in the second stage of analysis for calculation of integrations values (overall integration and integration of individual spaces), based on the overall integration of Maximum, mean and minimum, difference factor was calculated for each case using Microsoft excel.

Finally all the data was tabulated for comparison across cases and synthesis.

The following Space syntax techniques were used for the analysis of all the drawings of REMCs in the sample.

1) Case-1 Aju University Hospital:
① Location: Gyeonggi-do Province
② Operating Type: Stand Alone
③ Opening Year: 2002
④ Typology: Race Track

[Figure 2] Floor plan of emergency Medical Center Aju University Hospital

2) Case-2 Wonju Severance Christian Hospital:
① Location: Gangwon-do Province
② Operating Type: Mixed-Use
③ Opening Year: 2002
④ Typology: Pods combined with race track

11) Lee, J. H., Ostwald, M. J., & Gu, N. (2013). Combining Space Syntax and Shape Grammar to Investigate Architectural Style: considering Glenn Murcutt's domestic design. In: Kim, Y. O., Park, H. T. and Seo, K. W. (eds.), Proceeding of the Ninth International Space Syntax Symposium, Seoul: Sejong University, p.005.01-005.13.

12) Dursun, P. (2007). Space Syntax in Architectural Design. In: Kubat, A.S., Ertekin, Ö., Güney, Y.I. and Eyübolou, E. (eds.), Proceed -ing of the Sixth International Space Syntax Symposium, Istanbul: ITU Faculty of Architecture, p.10.

13) Bafna, S. (2003). Space Syntax a Brief Introduction to Its Logic and Analytical Techniques. Environment and Behavior, Vol. 35(1), p.17-29. doi: 10.1177/0013916502238863.

[Figure 3] Floor plan of emergency Medical Center Wonju Severance Christian Hospital

3) Case-3 Gachon University Gil Medical Center:

① Location: Incheon Metropolitan City

② Operating Type: Stand Alone

③ Opening Year: 1999

④ Typology: Pods combined with single corridor

[Figure 4] Floor plan of emergency Medical Center Gachon University Gil Medical Center

4) Case-4 The Catholic Univ. of Korea Uijeongbu ST. Mary's Hospital

① Location: Incheon Metropolitan City

② Operating Type: Stand Alone

③ Opening Year: 2004

④ Typology: Race track

[Figure 5] Floor plan of emergency Medical Center The Catholic Univ. of Korea Uijeongbu ST. Mary's Hospital

5) Case-5 Ulsan University Hospital:

① Location: Ulsan Metropolitan City

② Operating Type: Stand Alone

③ Opening Year: 2004

④ Typology: Pods combined with race track

[Figure 6] Floor plan of emergency Medical Center Ulsan University Hospital

6) Case-6 Chonnam National University Hospital:

① Location: Chonranam-do Province

② Operating Type: Stand Alone

③ Opening Year: 2001

④ Typology: Pods combined with race track

[Figure 7] Floor Plan of Emergency Medical Center of Chonnam National University Hospital

7) Case-7 Seoul National University Bundang Hospital:

① Location: Gyeonggi-do Province

② Operating Type: Stand Alone

③ Opening Year: 2006

④ Typology: Pods combined with single corridor

[Figure 8] Floor Plan of Emergency Medical Center of Seoul National University Bundang Hospital

4. Syntactic Analysis of the Cases

The analysis of the cases was started from justified graphs using AGraph software. Depth map was used for calculation of integration. The difference factor was calculated by MS Excel program. The following figure shows the procedure of analysis which is explained step by step below.
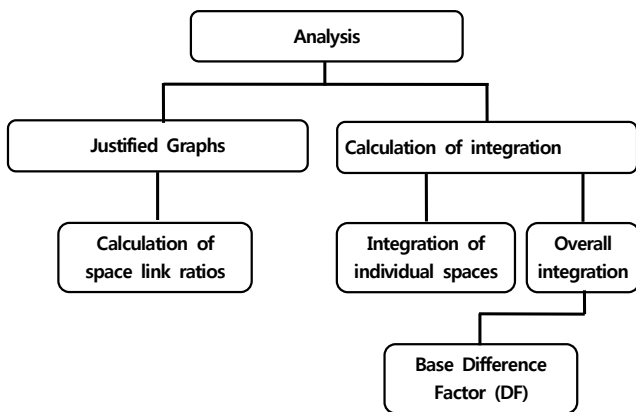
[Figure 9] Procedure of Analysis

4.1. Justified Permeability Graphs and the Space-link ratios

Integration value of any space is derived from consideration of its depth from all points within the Configurational system.

For this research purpose, the entry points of the REMC buildings were considered as root. All spaces that are directly accessible from the root i.e. of depth 1, were arranged horizontally above it, all spaces of depth 2 were arranged horizontally above the first and so on until all the spaces in the system were accounted for. All the connecting lines were then drawn in to show their relationships to each another. In [Table 4] the justified Graphs of corresponding layouts from their entrances are shown. These give a visual representation of 'depth' from a space, i.e. how shallow or deep it is in connection to all the other spaces in the system.

The space-link ratios of the all the graphs were calculated using the following formula and tabulated below:

The Space-link ratio=Number of links+1/number of spaces.

4.2. Calculation of Integration using Depth Map

The measure of integration, or its opposite, segregation, is expressed by Real Relative Asymmetry or RRA value. This value is obtained by the analysis of a graph representing the number of changes in direction between one axial line or space to all other lines or spaces. It is based on the number and depth of spaces that must be traversed from one space to all other spaces in the configuration. Mathematically, Integration is measured by the inverse of relative asymmetry (RA).[14]

This is given by the equation $RA=2(MD-1) / (k-2)$, where MD is the mean depth and k is the number of spaces in the system. Since the number of spaces is a consideration for RA, it follows that size can have an effect on the level of RA values in real systems. So, to compare between different sized systems, the modified unit Real Relative Asymmetry (RRA) is used.

This is comparison of RA values with those for a theoretical 'root' or a diamond shaped pattern. It is given by the equation $RRA = RA / Dk$, where Dk is the D-value of the system with the same number of spaces as the real system.

Therefore consideration of RRA values gives the opportunity to compare between environments.[15] Depth map software was used for the calculation of integration values of individual spaces as well as maximum, mean and minimum of the whole system. [Table 5] shows the integration values with and without exterior of all cases.

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14) Haq, Saif, 2001, "space syntax", in Complex Architectural Settings: An investigation of spatial and cognitive variables through wayfinding behavior, PhD Dissertation, Gorgia Tech, P.69

15) Haq, Saif, op. cit. p.69.

[Table 4] Step depth, Justified Graphs, Integration and syntactic Attributes summary of the sample

Case No.	Step depth	Justified Graph	Distribution of Integration (from red most integrated to dark blue segregated)	Syntactic Attributes summary
Case-1				
Case-2				
Case-3				
Case-4				
Case-5				
Case-6				
Case-7				

4.3. Base difference Factor (DF)

The base difference factor is the difference factor for minimum, maximum and mean integration values the complex, and thus gives some indication of how much differentiation is available which may or may not be taken up by the various functions.

The formula for calculation of difference factor is:

$$H= -\sum [a/t \ln(a/t)] + [b/t \ln(b/t)] + [c/t \ln(c/t)-(1)$$
$$H^*= H-\ln2/\ln3-\ln2 \text{----------------------------------}(2)$$

Where H is the unrelativised difference factor for three spaces, a, b and c are the integration values of the spaces and t is their sum.

This H is then relativised between ln2 and ln3 to give a "relative difference factor" H*, between 0 (the maximum difference and minimum entropy) and 2 (the minimum difference, or maximum entropy), that is all values are equal.[16] Base difference factor (DF) for maximum, mean and minimum integration values of each REMC was calculated with exterior and without exterior using the above formula.

5. Synthesis

Data from the above analysis is tabulated in [Table 5] below. The syntactic values show a very regular pattern of consistencies across the seven cases. These similarities of syntactic values for the different REMC buildings means that under the apparent different layout (Phenotype), there resides a consistent spatial structure of activities which is unique and can be realized only through the analysis of its spatial structure.

For instance the mean integration value of the sample is 0.88 with exterior and 0.89 without exterior, and the integration values of the cases are very stable around the mean value. This consistency is also present in the difference factor where the mean value is 0.75 with exterior and the same without exterior, and all the cases are very consistent with its mean value.

By further investigation of each case; the integration of clinical spaces was examined, the data for the order and values of the individual clinical spaces was compared across the sample [Table 6], which shows the following:

(1) First It was found that the Nurse station (N.S) is the most integrating space in all of clinical spaces, it takes on the 1st value of integration in case-2 to case-7, while in case-1 the N.S gets 2nd value of integration.

(2) Secondly the emergency patient treatment area (E.P.T.A) gets the 3rd, 2nd, 3rd, 2nd, 2nd and 4th value of integration from case-2 to case-7 respectively. While in case-1 its value is not even in the first five values and gets the 8th value of integration which is very different from the rest of the sample (Table 6).

(3) The observation beds (O.B) are located on 4th, 3rd, 3rd, 4th, 3rd and 3rd value of integration from case-2 to case-7 respectively. In case-1 the observation beds again not present in the first five values and takes on 10th position. This again is very different from the rest of the sample.

(4) Finally the Resuscitation room (Resus.) in case-2 to case-7 takes on the 3rd, 6th, 3rd, 3rd, 3rd and 5th value of integration respectively. While in case-1 it takes on the 11th value, again far away from the rest of the sample.

The above observations are summarized in graphic form on the right side of the [Table 6]. Now it is obvious that case-2 to case-7 exhibits the syntactic consistency to the deepest level. This type of underlying consistencies in case-2, case-3, case-4, case-5, case-6 and case-7 means that they can be grouped into one category on the level of their spatial structure. This type of spatial consistence group of buildings from a region irrespective of its external appearance (phenotype) are termed as Genotype. Case-1 which is quite different from the rest of the sample is non-genotype because its internal spatial structure is not consistence with the rest of the sample.

Although the integration value, the base difference factor and space link ratios of case-1, which is non-genotype are very consistence with the rest of the sample, and by looking those values it seems that it may belong to the same group.

In the final step of the analysis the syntactic values of the individual clinical spaces, which are consistent in the genotype were compared across the seven cases to have a much deeper insight of the difference.

[Table 7] shows the syntactic values of the nurse station (N.S) from case-1 to case-7 and on the right side the

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16) Hillier, Bill, Hanson, Julienne, & Graham, H. 1987, "Ideas are in things-An application of the space syntax method to discovering house genotypes", Environment and Planning B: Planning and design, Volume 14, p. 365

[Table 5] Space-link Ratio, Integration and Difference Factor of the Sample

| Case No.	Space-Link	Integration with Exterior			Base Difference Factor(DF)	Integration without Exterior			Base Difference Factor(DF)
	Ratio	Max	Mean	Min		Max	Mean	Min	
Case-1	1.20	1.37	0.89	0.45	0.78	1.37	0.89	0.44	0.77
Case-2	1.19	1.17	0.84	0.39	0.79	1.17	0.85	0.40	0.80
Case-3	1.19	1.42	0.99	0.51	0.81	1.44	1.01	0.51	0.81
Case-4	1.10	1.27	0.82	0.39	0.76	1.27	0.81	0.38	0.75
Case-5	1.33	1.23	0.88	0.44	0.81	1.23	0.88	0.45	0.82
Case-6	1.18	1.56	0.88	0.47	0.73	1.58	0.90	0.47	0.73
Case-7	1.10	1.65	0.86	0.35	0.60	1.68	0.87	0.35	0.59
Sample Mean	1.18	1.38	0.88	0.43	0.75	1.39	0.89	0.43	0.75

summary is represented by graph. In case-1 the step depth, the mean Depth (M.D) and control value(C.V) is different from the rest of the sample, while case-6 and case-7 also exhibits a different C.V. but the rest of attributes are consistent with the sample. While in case-1 only its integration HH is consistent with the sample.

[Table 8] shows the syntactic values of the Emergency patient treatment area from case-1 to case-7 and on the right side the summary is represented by graph.

[Table 6] Integration Order of the Individual Clinical Spaces and the Summary Graph

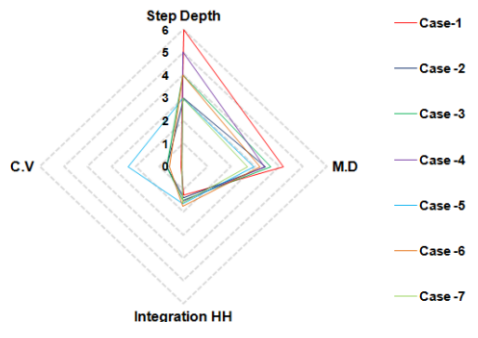| Case No.	From the Most Integrated to Segregated					Summary of integration order
	1	2	3	4	5	
Case-1	0.55= Triage	0.66=N.S	0.67=Medical consultant = Surgery = Gynecology	0.68= CT Scan	0.69= X-ray	
Case-2	0.65=N.S	0.71=Triage	0.74= E.P.T.A / 0.74=Resus. = Surgeon Room	0.78= O.B	0.88=PEDs Consultant	
Case-3	0.62= N.S	0.68=E.P.T.A	0.74=Observation	0.75=PEDs Treatment	0.76=Triage= X-ray=CT Scan	
Case-4	0.60= N.S	0.62=C.T Scan	0.65= E.P.T.A / 0.65= O.B = medical consultant / 0.65= Resus	0.73=X-Ray	0.76=Triage	
Case-5	0.56= Triage = N.S	0.62= E.P.T.A	0.63=Resus.	0.65= O.B	0.79=X-Ray	
Case-6	0.57= N.S	0.58= E.P.T.A / 0.58= O.B	0.73= PEDs treatment =Resus.= Ultra sound=Isolation	0.74= CT Scan	0.82=Doctor on duty=Nurse room	
Case-7	0.52= N.S	0.61=X-Ray	0.62= O.B	0.63 = E.P.T.A = Isolation	0.74= Resus.	
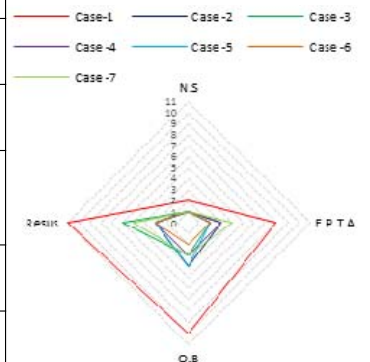
[Table 7] Syntactic Attributes of Nurse Station (Case-1 to Case-7)

Nurse Station					
Case No.	Step Depth	M.D	Integration HH	C.V	
Case -1	6	3.64	1.51	4.52	
Case -2	3	3.13	1.55	1.10	
Case -3	3	3.39	1.63	1.77	
Case -4	4	3.21	1.67	1.80	
Case -5	3	2.77	1.78	0.37	
Case -6	3	3.20	1.74	2.41	
Case -7	3	2.80	1.93	3.75	
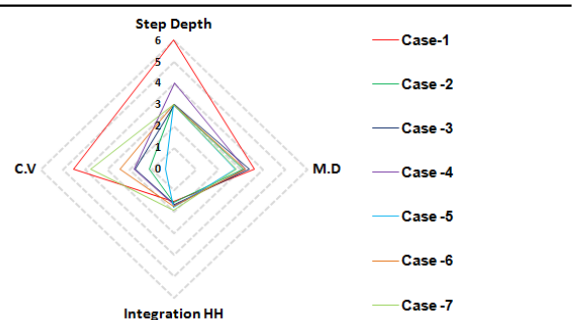
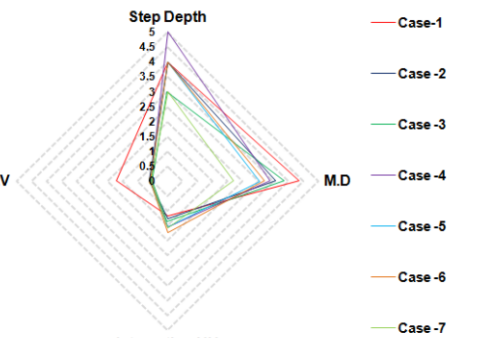**[Table 8]** Syntactic Attributes of Emergency Patient Treatment Area (Case-1 to Case-7)

Emergency Patient Treatment Area				
Case No.	Step Depth	M.D	Integration HH	C.V
Case -1	6	4.20	1.24	0.10
Case -2	3	3.45	1.35	0.71
Case -3	4	3.66	1.46	0.69
Case -4	5	3.41	1.51	0.05
Case -5	3	2.96	1.61	2.29
Case -6	4	3.22	1.73	0.58
Case -7	3	2.70	1.58	0.05

[Table 9] Syntactic Attributes of Observation Room (Case-1 to Case-7)

Observaion Room				
Case No.	Step Depth	M.D	Integration HH	C.V
Case -1	4	4.36	1.18	1.7
Case -2	4	3.58	1.28	0.61
Case -3	3	3.87	1.36	0.51
Case -4	5	3.40	1.54	0.55
Case -5	4	3.04	1.54	0.59
Case -6	4	3.22	1.73	0.58
Case -7	3	2.18	1.59	0.55

The step depth, mean depth (M.D) and integration HH values of case-1 are much higher from the rest of the sample only control value (C.V) is consistent with the sample. Although the step depth of case-4 is much higher (lesser than case) and case-5 is differing in Control value from the rest of the sample, but the rest of the values of these cases are much in line with the whole of the sample. Only case-1 is differing with major values.

[Table 9] shows the syntactic values of the Observation Room from case-1 to case-7 with a summary graph. The mean depth (M.D), integration HH and control value (C.V) values of case-1 are different from the rest of the sample only step depth is consistent with the sample. Again the step depth of case-4 is much higher from the rest of the sample, but the rest of the values of case-4 and all other cases are much in line with the whole of the sample. Only case-1 is differing with major values.

6. Discussion and Conclusion

The results of this study demonstrated that on a whole the Korean REMC buildings follow a consistence Configurational pattern in their syntactic values instead of quite different layout pattern. Apart from the case-1 the remaining six cases; that is the genotype exhibits not only a very similar space link ratios, integration and difference factor (DF) but also the internal integration order of the clinical spaces is very consistence. This means that the Korean REMCs embodies a socio-medical culture, which is strong enough that it is embedded into the configuration of its buildings. The integration values of the genotype cases exhibits that the clinical spaces of Korean REMCs follow a consistence logic in their layouts, whereas this logic is weaker in the non-genotype case.

The justified graphs and the space-link ratios shows that the layout of Korean REMCs tends to be a tree shaped, with fewer rings (Table 4). The space link ratios of the genotype cases range from 1.10-1.33 with mean 1.18, as shown in [Table 5]. As the space link ratios are nearer to 1, this means a tree like configurations with controlled movement.

That is movement in Korean REMCs varies from a

controlled, sequential and not confused to partially controlled movement. This type of layouts indicates that the Korean medical and nursing profession tends towards an established nursing and medical practice.

The public areas of the REMCs are in most of the cases; in highly integrated zones and are ringy, where movement is much frequent.

Based on the above it can be concluded that:

(1) With different size, different locations and even different architects, there exists a consistent underlying pattern (Genotype) in korean REMCs which can be detected through spatial analysis.

(2) The Korean REMCs follows a logical order in its configuration where the primary focused space is:

① The Nurse station

while Emergency patient treatment area, Resuscitation and Observation room occupy 2nd, 3rd and 4th places interchangeably.

(3) The results of this study shows that how space syntax may be used for practical opportunities of evaluation and design of REMC buildings.

(4) If compared with further cases of national and international REMCs, the results of this study may provide a base line for the analysis and evaluations of future designs of REMCs in terms of spatial configuration and activity patterns.

(5) The non-Genotype case represents a deviation from standard configuration of Korean REMC, which needs further studies to be labeled as good or bad in terms of its emergency medical operations.

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